

CLAIMS

What is claimed is:

1. A negative active material of a rechargeable lithium battery comprising:
a crystalline carbon core having an intensity ratio $R_a I(1360)/I(1580)$ of a Raman Spectroscopy peak intensity $I(1360)$ at a (1360) plane to an Raman Spectroscopy peak intensity $I(1580)$ at a (1580) plane of substantially 0.01 to 0.45; and
a shell with a turbostratic or half-onion ring structure coated on the core, the shell comprising crystalline carbon micro-particles and semi-crystalline carbon, the shell having an intensity ratio $R_a I(1360)/I(1580)$ of a Raman Spectroscopy peak intensity $I(1360)$ at a (1360) plane to an Raman Spectroscopy peak intensity $I(1580)$ at a (1580) plane of substantially 0.46 to 1.5.
2. The negative active material of claim 1, wherein the crystalline carbon micro-particles have an average diameter (D50) of substantially 0.1 to 15 μm .
3. The negative active material of claim 1, wherein the crystalline carbon micro-particles have a plate shape.
4. The negative active material of claim 1, wherein the negative active material has a tapping density of substantially 1.20 to 1.50 g/cc.
5. The negative active material of claim 1, wherein the crystalline carbon are natural graphite or artificial graphite.
6. The negative active material of claim 1, wherein an amount of the shell is substantially 0.01 to 15 wt% based on a weight of the negative active material.
7. The negative active material of claim 1, wherein the negative active material has an average diameter of substantially $25 \pm 5 \mu\text{m}$.

8. The negative active material of claim 1, wherein the negative active material has a BET , specific surface area, of substantially 2.0 to 4.0 m²/g.

9. The negative active material of claim 1, wherein the negative active material has an intensity ratio I(110)/I(002) of an X-ray diffraction peak intensity I(002) at a (002) plane to an X-ray diffraction peak intensity I(110) at a (110) plane of less than 0.01.

10. A method of preparing a negative active material of a rechargeable lithium battery comprising:

pulverizing crystalline carbon to prepare crystalline carbon particles and crystalline carbon micro-particles;

spherically-shaping the crystalline carbon particles to prepare spherical crystalline carbon;

agglomerating the spherical crystalline carbon and the crystalline carbon micro-particles to prepare primary particles;

coating the primary particles with amorphous carbon to prepare secondary particles; and heat-treating the primary particles coated with the secondary particles.

11. The method of claim 10, wherein the crystalline carbon particles have a plate shape.

12. The method of claim 10, wherein the mixing ratio of the spherical crystalline carbon and the crystalline carbon micro-particles is substantially 70 to 99.99:0.01 to 30 by weight ratio.

13. The method of claim 10, wherein the mixing ratio of the primary particles and the amorphous carbon is substantially 50 to 99.99 wt%:0.01 to 50 wt%.

14. The method of claim 10, wherein the heat-treating operation is performed at 1000 to 3200 °C.

15. The method of claim 14, wherein the heat-treating operation is performed at 2000 to 2700 °C.

16. The method of claim 10, wherein the crystalline carbon particles have an average diameter (D50) of substantially 5 to 50 μm and the crystalline carbon micro-particles have an average diameter (D50) of substantially 0.1 to 15 μm .

17. The method of claim 10, wherein the amorphous carbon is a coal tar pitch or petroleum pitch.

18. A negative active material of a rechargeable lithium battery comprising:
a crystalline carbon core; and
a carbon shell coated on a surface of the crystalline carbon core, the carbon shell comprising crystalline carbon micro-particles.

19. The negative active material of claim 18, wherein an intensity ratio $\text{Ra I}(1360)/\text{I}(1580)$ of a Raman Spectroscopy peak intensity $\text{I}(1360)$ at a (1360) plane to an Raman Spectroscopy peak intensity $\text{I}(1580)$ at a (1580) plane of the shell is larger than an intensity ratio $\text{Ra I}(1360)/\text{I}(1580)$ of a Raman Spectroscopy peak intensity $\text{I}(1360)$ at a (1360) plane to an Raman Spectroscopy peak intensity $\text{I}(1580)$ at a (1580) plane of the core.

20. The negative active material of claim 19, wherein the crystalline carbon core has an intensity ratio $\text{Ra I}(1360)/\text{I}(1580)$ of a Raman Spectroscopy peak intensity $\text{I}(1360)$ at a (1360) plane to a Raman Spectroscopy peak intensity $\text{I}(1580)$ at a (1580) plane of substantially 0.01 to 0.45 and the shell has an intensity ratio $\text{Ra I}(1360)/\text{I}(1580)$ of a Raman Spectroscopy peak intensity $\text{I}(1360)$ at a (1360) plane to an Raman Spectroscopy peak intensity $\text{I}(1580)$ at a (1580) plane of substantially 0.46 to 1.5.

21. The negative active material of claim 18, wherein the carbon shell is semi-crystalline carbon.

22. The negative active material of claim 18, wherein the negative active material has an X-ray diffraction intensity ratio ($\text{I}_{110}/\text{I}_{002}$) of less than 0.01 and a BET surface area of approximately 2.3 to 3.6 m^2/g .

23. The negative active material of claim 18, wherein the crystalline carbon micro-particles have a plate shape.

24. The negative active material of claim 18, wherein the negative active material has a tapping density of substantially 1.20 to 1.50 g/cc.

25. The negative active material of claim 18, wherein the crystalline carbon microparticles are natural graphite or artificial graphite.

26. The negative active material of claim 18, wherein an amount of the carbon shell is substantially 0.01 to 15 wt% based on a weight of the negative active material.

27. The negative active material of claim 18, wherein the negative active material has an average diameter of substantially $25\pm 5 \mu\text{m}$.

28. The negative active material of claim 18, wherein the negative active material has a BET, specific surface area, of substantially 2.0 to 4.0 m^2/g .

29. The negative active material of claim 18, wherein the negative active material has an intensity ratio $I(110)/I(002)$ of an X-ray diffraction peak intensity $I(002)$ at a (002) plane to an X-ray diffraction peak intensity $I(110)$ at a (110) plane of less than 0.01.